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Ethical Perception of Golden Rice in Malaysia

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ABSTRAK

Golden rice was developed by the insertion of carrot gene into rice to solve vitamin A deficiency problem. Past studies have shown that consumer acceptance of genetically modified (GM) food is driven by many factors, of which moral aspects was found to be an important predictor or sometimes referred to as 'a veto' of support. The purpose of this paper is to examine how the Malaysian public in the Klang Valley region perceive the ethical aspects of golden rice. A set of questionnaire comprising of the ethical aspects of golden rice was distributed and completed by 208 Muslims residing in the Klang Valley area. Results of factor analysis showed that there are four components or dimensions of ethical aspects of golden rice. The dimensions are familiarity, perceived risks, denying benefits (if not carried out) and ethical acceptance. Cronbach alpha values for the all dimensions were good: familiarity (α=0.82), denying benefits (α=0.77), perceived risks (α=0.78) and ethical acceptance (α=0.84). Results from the survey has shown that majority of the respondents perceived the ethical aspects of golden rice as moderate except for the professionals who surprisingly claimed to have only low familiarity with golden rice while the clerical workers and the un-employed on the other hand, perceived high benefits and were highly accepting of the ethical aspects of golden rice.

Key words: Ethical aspect, golden rice, genetically modified food, Klang Valley

ABSTRAK

Padi emas telah dibangunkan secara pemindahan gen lobak merah ke dalam padi untuk menyelesaikan masalah kekurangan vitamin A. Kajian lepas telah menunjukkan bahawa penerimaan konsumer terhadap makanan terubahsuai secara genetik (GM) dipengaruhi oleh pelbagai faktor, di mana aspek etika merupakan peramal utama atau kadangkala dirujuk sebagai 'kuasa veto' sokongan terhadap makanan GM. Tujuan kertas kerja ini adalah untuk mengkaji persepsi masyarakat Malaysia terhadap aspek etika padi emas. Satu set soal selidik yang mencakupi aspek-aspek etika padi emas telah diedarkan dan dilengkapi oleh 208 orang responden berugama Islam di sekitar kawasan Lembah Klang. Hasil analisis faktor menunjukkan terdapat empat komponen atau dimensi aspek etika padi emas. Dimensi-dimensi tersebut adalah kebiasaan, penafian faedah (jika tidak dilakukan), persepsi risiko dan penerimaan etika. Nilai alpha Cronbach untuk setiap komponen adalah baik: kebiasaan (α=0.82), penafian faedah(jika tidak dilakukan) (α=0.77) risiko (α=0.78) dan penerimaan etika (α=0.84). Hasil kajian menunjukkan bahawa sebahagian besar responden mempunyai persepsi yang sederhana terhadap aspek etika padi emas kecuali dapatan golongan profesional yang memeranjatkan, dimana mereka mengaku hanya mempunyai tahap kebiasaan yang rendah terhadap padi emas, sementara golongan perkeranian dan golongan tidak bekerja pula menilai padi emas sebagai mempunyai faedah dan penerimaan aspek etika yang tinggi.

Kata kunci: Aspek etika, padi emas, makanan terubahsuai secara genetik, Lembah Klang

INTRODUCTION

Rice is the major staple food for millions of people in the world. However, 400 million poor people in rice-based societies have Vitamin A deficiency (Mayer 2005). Vitamin A deficiency contributes a serious health problem in at least 26 countries including highly populated areas of Asia, Africa and Latin America (Beyer et al. 2002). Paine et al. (2005) indicated that Vitamin A deficiency can result in permanent blindness and also contribute to the increasing incidence and severity of infectious disease. Consequently, 500 children per year go blind and 1.15 million Vitamin A deficiency-precipitated deaths were reported among children worldwide (Mayer 2005). Therefore, the development of golden rice fortified with the pro-vitamin A hopefully will alleviate this problem. By using genetic engineering techniques, carrot gene was inserted into the rice endosperm to produce pro-vitamin A via carotenoid biosynthesis. Carotenoids are groups of plant pigments which is important for human diet. One of the carotenoids, β-carotene which is a pro-vitamin A turns into retinol (vitamin A) when entering the human body. Mayer (2005) indicated that every plant produces pro-vitamin A in their green tissues and then will be converted into vitamin A in the human body. The GM crop, known as Golden Rice was found capable of producing 23 times more pro-vitamin A (betacarotene) compared to a prototype announced in the year 2000 (Paine et al. 2005).

Since 1999, the year Ingo Potrykus and Peter Beyer run a project on a rice plant capable of producing provitamin A, the Golden Rice has been widely discussed (Mayer 2005). Paula (2001) indicated that by not having a profesional ethical code as the reason why biotechnology suffers from a lack of public trust and acceptance of its products. Past studies have shown that consumer acceptance of genetically modified (GM) food is driven by many factors, of which moral aspects was found to be an important predictor or sometimes referred to as 'a veto' of support(Gaskell et al 2000). Basic categories of moral or ethical concerns regarding modern biotechnology fall into two classes: intrinsic and extrinsic (Comstock, 2000). Extrinsic objection refers to the concerns regarding the application of the technologies such as the possible risks of different application of biotechnology. Intrinsic objection allege that the process of modern biotechnology is objectionable in itself.

Every new technology comes together with benefits and also risks. According to Ebbersen & Pedersen (2007), risks referring to a possible future harm. There are two types of risks, technology-inherent risks and technology transcending risks. Technology-inherent risks arise when a technical action plan is designed to improve an existing situation, but then during the research or implementation phase unforeseeable problems and unwanted "side effects" crop up while technology-transcending risks emanate from the application of a technology in certain political and social circumstances (Leisinger 2007).

Familiarity is another important dimension cited in risk perception researches (Rowe 2004). Slovic et al (2004) found that five characteristics correlated highly with each other which reflected familiarity. They were observability, knowledge (known to those exposed), immediacy consequences, familiarity (not new) and known to science. Using principal component analysis, Kirk et al. (2002) found that familiarity component comprised of items on whether it is easy to tell whether a product contain a risky substance, whether the risk is known to science and whether a person has control over consuming a certain product. According to BABAS (1999), denying the potential benefits of modern biotechnology by not developing the technology is also an ethical concern. The beneficial aspects of a technology include benefits for an individual, benefits for society, contribution to human needs and relevance to human needs (Rohrmann 1999).

Risks, familiarity, benefits and ethical acceptance seems importance for public acceptance of modern biotechnology Therefore, the objectives of this paper are to identify the relevant ethical dimensions and to study the Muslims' perception of the ethical aspects of golden rice

MATERIAL AND METHODS

Data for this study was collected by means of survey. The multi-dimensional instrument to measure ethical aspects of modern biotechnology used in this study was constructed based on the work of earlier researches (Latifah 2007; Comstock 2000; Gaskel et al. 2003; BABAS 1999; Glenn 2004; Singh et al 2006; Gott & Monamy 2004). All items were measured on 7 point Likert scales. The questionnaires were administered face to face to 213 Muslims in the Klang Valley region stratified according occupations (MASCO 1998). Klang Valley including two federal territories, Putrajaya and Kuala Lumpur was chosen as sampling area because the population in this area met the various requirement needed in this study.

Data analysis was carried out using the SPSS (Statistical Package for Social Science) version 14. There are 2 tests used: factor analysis and reliability test (Cronbach's alpha). Factor analysis is commonly used to refine and reduce scale items and question to form a smaller number of coherent subscales (Pallan 2005). According to Sabitha Marican (2006), the function of factor analysis is to sort items constructed into small group which possess statistic association between one and other. Meanwhile reliability test was used to measure the consistency of the scales whether the items measuring the same underlying constructs (Pallan 2005).

RESULTS AND DISCUSSION

Factor analysis

The Kaiser-Meyer-Olkin (KMO) value was 0.81 exceeding the recommended value of 0.60 (Kaiser 1970, 1974) and the Barlett's Test of Sphericity (Barlett 1954) reached statistical significance supporting the factorability of the correlation matrix. Principal components analysis revealed the presence of four components with eigenvalues exceeding 1. Table 1 shows that four dimensions of the ethical aspects of golden rice were obtained**.** These dimensions were labeled as ethical acceptance, risks, familiarity and denying benefits (if not carried out). The first dimension, ethical acceptance of golden rice consists of five items. Six items were grouped in the perceived risks dimension. Meanwhile, four items belongs together under the third dimension, familiarity and the last dimension, denying benefit includes only three items under it.

Table 1. Rotated factor loadings from Principal Components Analysis using varimax rotation of the ethical aspects of golden rice

Item	Factor Loadings*			
	Factor 1 Ethical acceptance	Factor 2 Perceived Risks	Factor 3 Familiarity	Factor 4 Denying benefits
More intensive development	0.87			
More financial support from government	0.77			
Should be encouraged	0.70			
Should be commercialized	0.70			
Risk minimal compared to other dangers	0.58			
Threaten natural order of things	0.76			
Reduce status of living things to machines	0.73			

Worry to consume	0.68			
Ecosystem imbalance	0.67			
'Playing God'	0.67			
Extinction of original species	0.58			
Easy to judge		0.83		
Easy to know		0.79		
The effect well known		0.78		
Inadequate information		0.77		
Boost of country economy denied			0.69	
Improvement of farmer's life denied			0.69	
Improvement of Malaysia society denied			0.67	

*Note: Only factor loadings greater than or equal to 0.50 were recorded for ease of interpretation.

Reliability Test

Ideally, the Cronbach's alpha coefficient of a scale should be above 0.70 (Pallan 2005). In this study, the Cronbach's alpha coefficients obtained for all dimensions: ethical acceptance (α=0.84), perceived risks (α=0.78), familiarity (α=0.82) and denying benefits (α=0.77) are above 0.70 (Table 2). Therefore, the reliability of these scales can be considered good. Corrected item-total correlation indicates the degree to which each item

Table 2. Item total correlation of ethical aspects items and Cronbach's coefficient alpha

Component	Item	Corrected Item-total correlations	Alpha if item deleted	Cronbach's alpha
Ethical acceptance	Risk minimal compared to other dangers	0.45	0.86	0.84
	More intensive development	0.71	0.79	
	Should be commercialized	0.72	0.79	
	More financial support from government	0.64	0.81	
	Should be encouraged	0.72	0.78	
Perceived risks	Threaten natural order of things	0.61	0.73	0.78
	'Playing God'	0.49	0.76	
	Reduce status of living things to machines	0.59	0.73	
	Worry to consume	0.55	0.74	
	Extinction of original species	0.43	0.77	
	Ecosystem imbalance	0.52	0.75	
Familiarity	Easy to know	0.63	0.77	0.82
	Easy to judge	0.70	0.74	
	The effect well known	0.63	0.77	
	Inadequate information	0.58	0.79	
Denying benefits (if not developed)	Boost of country economy denied	0.58	0.71	0.77
	Improvement of Malaysia society denied	0.61	0.68	
	Improvement of farmer's life denied	0.62	0.67	

correlates with the total score. All of the items in the four dimensions achieved item-total correlations above 0.3, meaning the items are measuring the same thing as the scale as a whole (Table 2). This study is supported by Pallan (2005) who indicated that item-total correlation values greater than 0.3 showed that the item is measuring the same underlying construct.

Ethical Perception of Golden Rice

From Table 3, it can be seen that only the professionals claimed to have low familiarity with golden rice as compared to the other groups of respondents who professed to have moderate familiarity. This finding is quite surprising as this group of respondents were the most educated. The professionals and another four groups of respondents, excluding the clerks, craft related workers and un-employed perceived only moderate benefits of golden rice. On the other hand, the clerks, craft related workers and un-employed have high mean score for the factor denying benefits of golden rice meaning if golden rice was not developed, the public will not be able to reap the benefit from it such as the boost of country's economy, improvement of quality of life, and improvement of farmers' life. Golden Rice was genetically modified to solve the vitamin A deficiency problem. It is not expected to provide 100% of vitamin A requirement in the diet, but the development hopefully will add to the present intakes to reach vitamin A sufficiency.

Table 3. Familiarity and denying benefits across groups of occupations

Groups of respondents	Familiarity		Denying benefits	
	Mean score ± std dev.	Interpretation*	Mean score ± std dev.	Interpretation*
Professionals	2.84 ± 1.26	Low	4.54 ± 1.43	Moderate
Technicians and associate professionals	3.15 ± 1.47	Moderate	4.98 ± 1.36	Moderate
Clerical workers	4.15 ± 1.14	Moderate	5.03 ± 1.16	High
Service, shop and sale workers	3.59 ± 1.48	Moderate	4.80 ± 1.49	Moderate
Craft and related trade workers	4.17 ± 1.41	Moderate	5.18 ± 1.19	High
Plant and machine operators and assemblers	2.94 ±1.22	Moderate	4.83 ± 1.29	Moderate
Elementary occupations	3.53 ± 1.50	Moderate	4.17 ± 1.62	Moderate
Un-employed (students, housewives and pensioners)	3.68 ± 1.35	Moderate	5.14 ± 1.12	High

* *Mean score 1-2.99: low, 3.0-5.0: moderate, 5.1-7.0 high*

Table 4 showed that all the groups of respondents perceived the risks aspects of Golden rice as moderate. The craft related workers and the un-employed were highly accepting of the ethical aspects of golden rice while the remaining group of respondents were moderately accepting of the ethical aspects of golden rice.

Golden Rice, surveyed in this study involved the transfer of gene from plant to plant (carrot gene to rice). This could be the reason why it is not highly opposed by the Muslims respondents in this study. This is supported by an earlier study by Frewer et al. (1995) who reported that the transfer of genetic material between organisms of the same type (for example in this study between plant and plant) was seen as less risky or less ethically objectionable than transfers between different types of organisms (for example between plant and animals). Macer (2001) also found that plant-plant gene transfers were the most acceptable, followed by animal-animal and plant or human-animal gene transfers being least acceptable.

Table 4. Ethical acceptance and perceived risks across groups of occupations

Groups of respondents	Perceived Risks		Ethical acceptance	
	Mean score ± std dev.	Interpretation*	Mean score ± std dev.	Interpretation*
Professionals	4.05 ±1.21	Moderate	4.87 ± 1.19	Moderate
Technicians and associate professionals	4.01 ±1.10	Moderate	4.72 ± 1.68	Moderate
Clerical workers	3.91 ±1.23	Moderate	5.04 ± 1.13	High
Service, shop and sale workers	4.11 ±1.22	Moderate	4.66 ± 1.09	Moderate
Craft and related trade workers	3.92 ±1.41	Moderate	4.70 ± 1.04	Moderate
Plant and machine operators and assemblers	3.91 ± 1.22	Moderate	4.87 ± 0.93	Moderate
Elementary occupations	3.73 ±1.24	Moderate	4.36 ± 1.10	Moderate
Un-employed (students, housewives and pensioners)	3.94 ±1.19	Moderate	5.20 ± 1.03	High

* *Mean score 1-2.99: low, 3.0-5.0: moderate, 5.1-7.0 high*

CONCLUSION

From this study it can be concluded that the Muslim respondents were moderately accepting of the ethical aspects of Golden Rice as it only involved the transfer of gene from plant to plant (carrot gene to rice) and the benefit is obvious to the consumers. However further study is needed to understand the reason why the professionals seemed to have low familiarity with GM rice and were not highly appreciating the benefits of GM rice.

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REFERENCES

BABAS. 1999. Ethical aspects of Agricultural Biotechnology. *Report of the EFB Task Group on Public Perceptions of Biotechnology*. Cambridge Biomedical Consultants, The Hague.

Barlett, M.S. 1954. A note on the multiplying factors for various chi square approximations. *Journal of the Royal Statistical Society* 16 (Series B): 296-298

Beyer, P., Salim Al-Babili, Xudong Ye, Lucca, P.,Schaub, P., Welsh, R., Potrykus, I. 2002. Golden Rice: Introducing the β-Carotene Biosynthesis Pathway into Rice Endosperm by Genetic Engineering to Defeat Vitamin A Deficiency. American Society for Nutritional Sciences.

Briggs, S.R. & Cheek, J.M. 1986. The role of factor analysis in the development and evaluation of personality scales. *Journal of Personality* 54: 106-148

Comstock, G.. Ethics and genetically modified crops. *A brief for the Royal Commission on Genetic Modification of New Zealand*., 8 October 2000.

Ebbesen, M. & Pedersen, B.D. 2007. Empirical investigation of the ethical reasoning of physicians and molecular biologists-the importance of the four principles of biomedical ethics. *Philosophy, Ethics, and Humanities in Medicine* 2: 23

Frewer, L.J., Howard, C. Stepherd, R. 1995. Genetic engineering and food: what determines consumer acceptance? *British Food Journal* 97(8) : 31-36

Gaskell, G., Alum, N., Baouer, M., Durant, J., Allansdottir, A., Bonfadelli, H., Boy, D., Cheveigne, D.S., Fjaestad, B., Gutteling, J.M., Hampel, J., Jelsoe, E., Jesuino, J.G., Kohring, M., Krongerger, N., Midden, C., Nielsen, T.H., Przestalski, A., Rusanen, T., Sakellaris, G., Torgersen, H., Twardowski, T. & Wagner, W. 2000. Biotechnology and the European public. *Nature Biotechnology* 18: 935-938

Gott, M. & Monamy, V. 2004. Ethics and transgenesis: toward a policy framework incorporating intrinsic objections and societal perceptions. *ATLA 32*, Supplement 1: 391-396.

Glenn, L.M. 2004. Ethical issues in Genetic Engineering and Transgenics. http://www.actionbioscience.org/biotech/glenn.html [10.8.2008]

Kaiser, H. 1970. A second generation Little Jiffy. *Psychometrika* 35: 401-415

Kaiser, H. 1974. An index of factorial simplicity. *Psychometrika* 39: 31-36

Kirk, S.F.L., Greenwood, D., Cade, J.E. & Pearman, A.D. 2002. Public perception of a range of potential food risks in the United Kingdom. *Appetite* 38: 189-197

Latifah, A. 2007. Public attitude towards modern biotechnology in Malaysia: A study in the Klang Valley region. Thesis submitted in fulfillment for the degree of doctor of philosophy. Pusat Pengajian Siswazah. Universiti Kebangsaan Malaysia

Leisinger, K.M. 2007. Ethical and ecological aspects of industrial property rights in the context of genetic engineering and biotechnology. Annual Review Syngenta Foundation for Sustainable Agriculture

Macer, D.R.J. 2000. Bioethics: perceptions of biotechnology and policy implications. International Journal of Biotechnology 3: 116-133

Mayer, J.E. 2005. Development and Impact of Golden Rice. Paper presented in FDA Science Forum, Washington DC 25 April 2005

Mayer, J.E. 2005. The Golden Rice Controversy: Useless Science or Unfounded Criticism? BioScience • *September 2005 / Vol. 55 No. 9*

Nap, J.P., Metz, P.L.J., Escaler, M., Conner, A.J. 2003. The release of genetically modified crops into the environment. Part 1. Overview of current status and regulations. *The Plant Journal* 33: 1-18

Pallan, J. 2005. SPSS Survival Manual. 2nd Edition. Open University Press.

Paula, L. 2001. Ethics: the key to public acceptance of biotechnology?. *Biotechnology and Development Monitor*, no. 7. P 22-23

Rohrmann, B. 1999. *Risk perception research: review and documentation*. 1999. Research Center Juelich: RC Studies #68. http://www.kfa-juelinch.de/mut/hefte/heft_69.pdf (3.6.2009)

Rowe, G. 2004. How can genetically modified foods be made publicly acceptable? . *Trend in Biotechnology* 22(3): 107-109.

Sabitha Marican. 2006. Penyelidikan Sains Sosial Pendekatan Pragmatik. Batu Caves, Selangor: Edusystem Sdn. Bhd.

Singh, O.V., Ghai, S., Paul, D., Jain, R.K. 2006. Genetically modified crops: success, safety assessment, and public concern. Mini Review. Applications of Microbiology *Microbiotechnology* 71: 598-607.

Slovic, P., Fischhoff,B. & Lichtenstein,S. 2004. Facts and fears: understanding perceived risk. In Slovic,P. (ed). *The perception of risk*: 140-153. London and Sterling: Earthscan.

Tabachnick, B.G. & Fidell, L.S. 2001. Using multivariate statistics. 4th Ed. New York: Harper Collins.

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